2004 DOE Hydrogen, Fuel Cells & Infrastructure Technologies

Program Review Presentation

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GE Global Research

May 2004

This presentation does not contain any proprietary or confidential information

Objectives

Under this DOE Contract, GE Global Research's Hydrogen Production Team are researching methods to achieve considerable reduction in alkaline *electrolyzer system* costs, compared to prevailing prices of available new equipment.

We may do this by;

•technological advances

•production methods

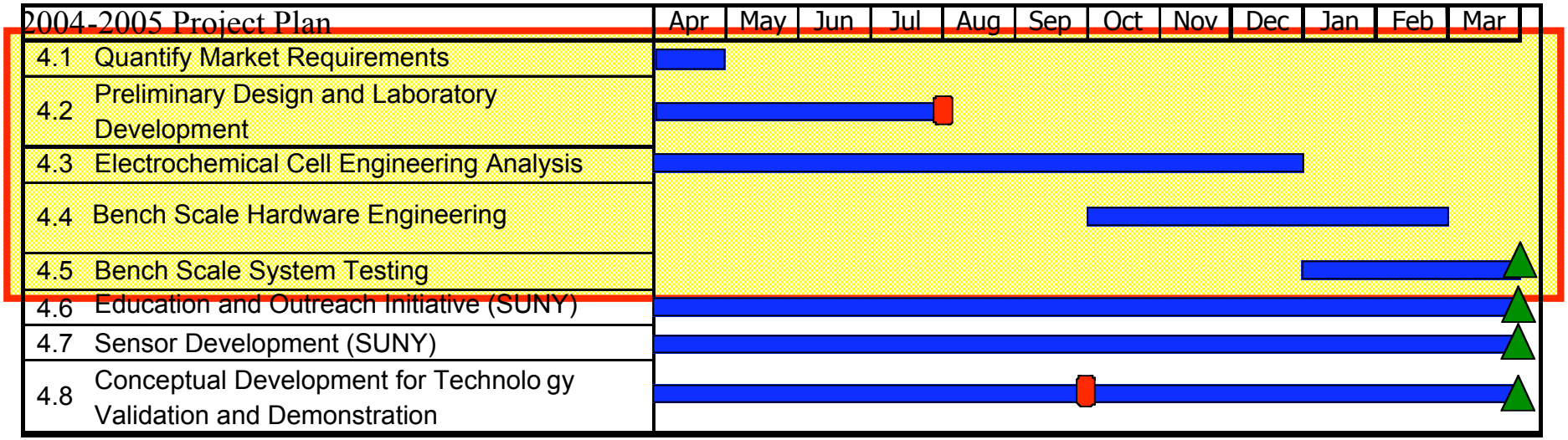
•materials of construction

•or a combination of these.

Appropriate physics-based performance and cost models will be used to allow detailed trade-off analyses to identify practicable performance and cost solutions.

2004 Budget

for highlighted electrolyer = $1.4M



Milestones:

M4.2 - Preliminary analysis complete and component targets identified.

M4.8 - Conceptual site layout complete.

Deliverables:

D4.5 - Design document summarizing the results and business path to commercializ ation.

D4.6 – Curriculum and outreach program to disseminate hydrogen knowledge. Technical, market and economic databases.

D4.7 – Reference design of novel, optical H2 sensor and performance report.

D4.8 – Virtual tour of New Baltimore site.

Technical Barriers and Targets (1)

From DOE's Technical Plan – Hydrogen Production,
"By 2010, verify renewable integrated hydrogen production with water electrolysis at a hydrogen cost of $2.50/kg (electrolyzer capital cost of $300/kWe for 250 kg/day at 5,000 psi with 73% system efficiency). By 2010, verify large-scale central electrolysis at $2.00/kg hydrogen at the plant gate."

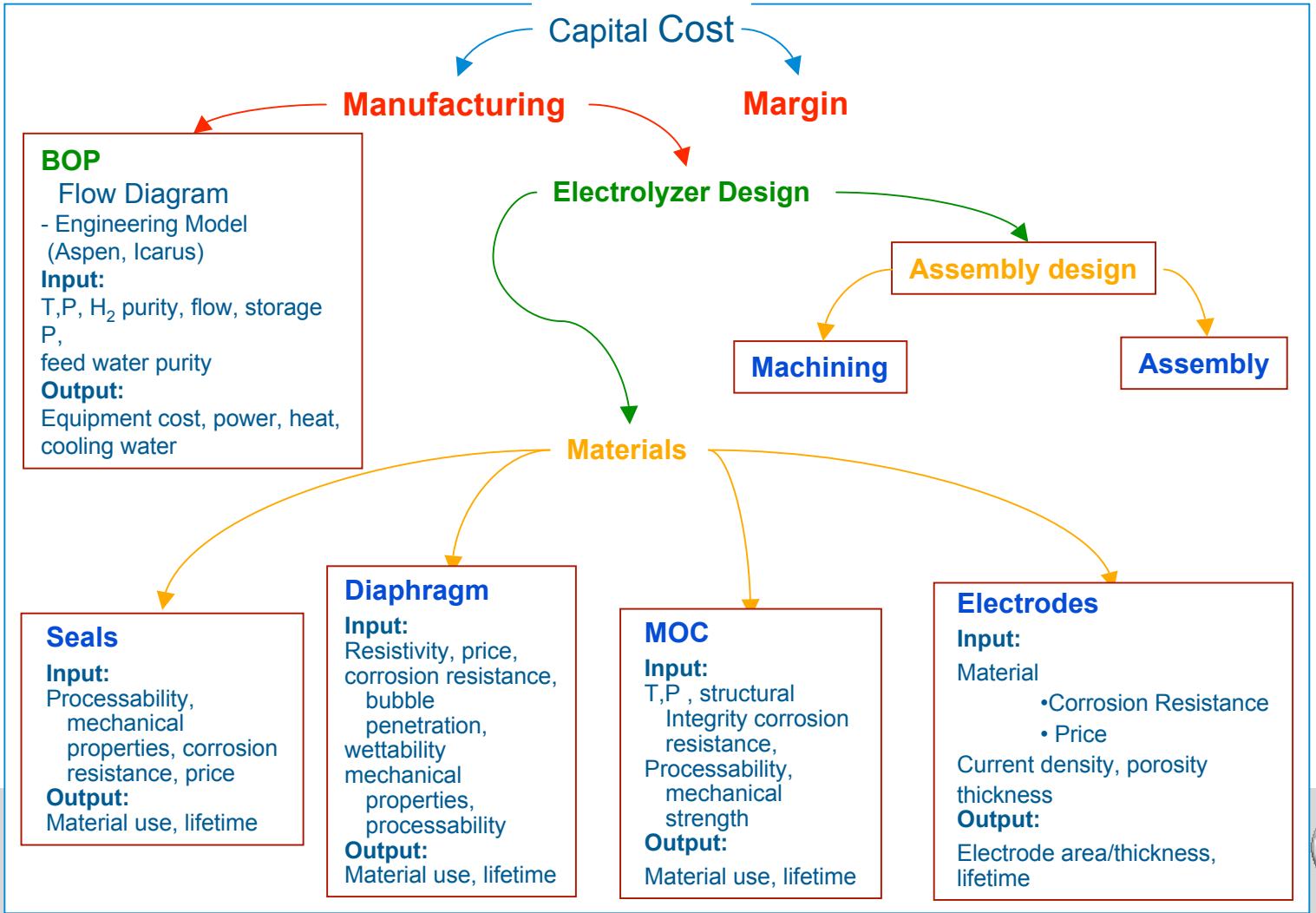
Presently available alkaline electrolyzers cost in the region of $4000/kW to $20,000/kW (or $200,000/kgh^{-1} to $1,000,000/kgh^{-1}). (This may not include compression to 5000psi.)

Main barriers include

1. Low volumes of manufacture – efficient assembly
2. System integration issues
3. Operating parameters
4. Materials of construction

Technical Barriers and Targets (2)

Program purpose is to understand how the capital costs are distributed for an ***electrolyzer system*** and to use this knowledge to drive a targeted cost reduction exercise to yield a cost-effective solution.



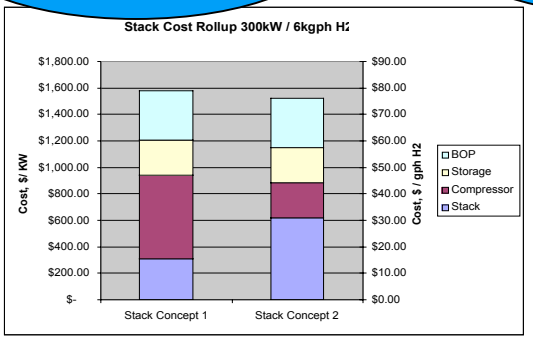
Technical Approach

Current Cost

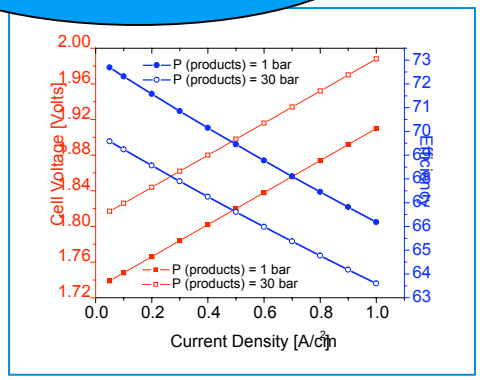
Current technology entitlement ?/ kgh^{-1}

Optimal Cost

Modeling optimizes system parameters



Modeling optimizes stack performance



Leverage GE manufacturing expertise for low-cost stack construction

Incremental improvement

High Pressure Stack

High Efficiency Stack

Novel Compression Methods

Game-Changers

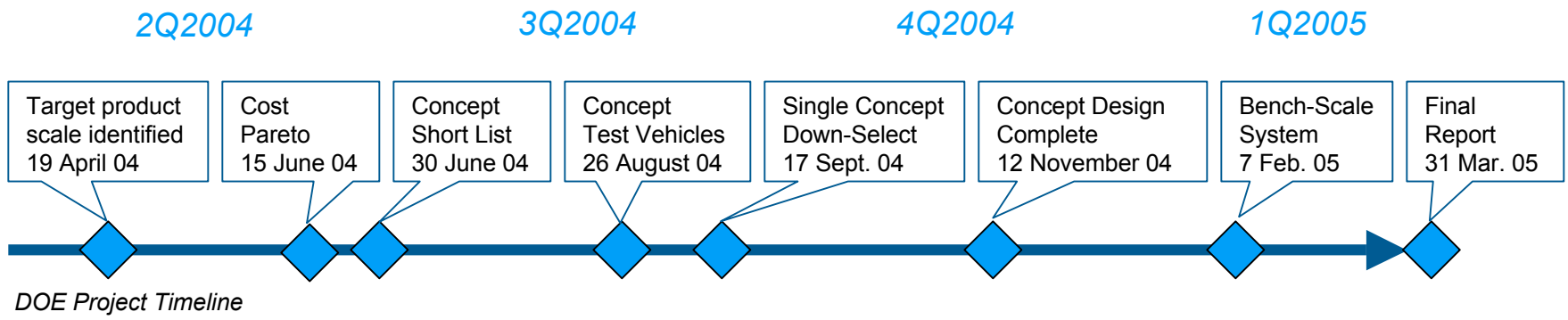
Learn the rules, then break the rules.

Project Safety

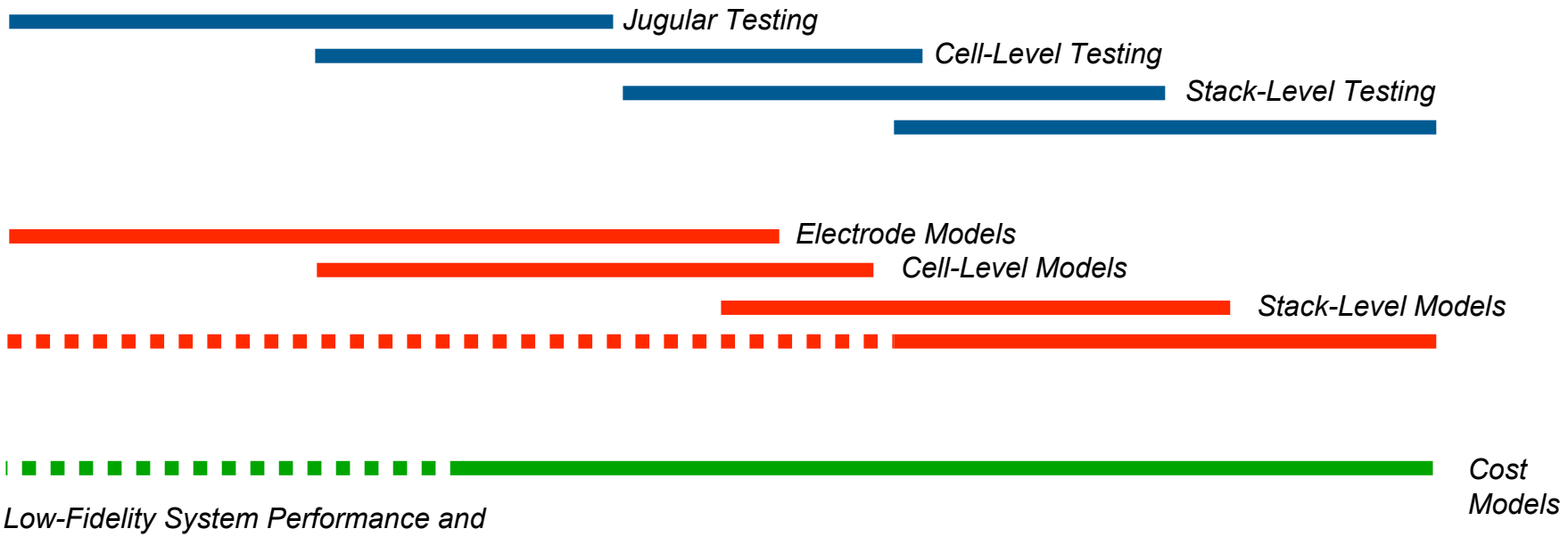
Risks arise from;

1. Flammability of H_2
2. Strong caustic electrolyte (KOH)
3. Temperature and pressure of stack and system
4. *Voltage* of electrical supply to system
5. High stack *current*
6. Mechanical risks occurring during equipment assembly and erection

Project Timeline (1)

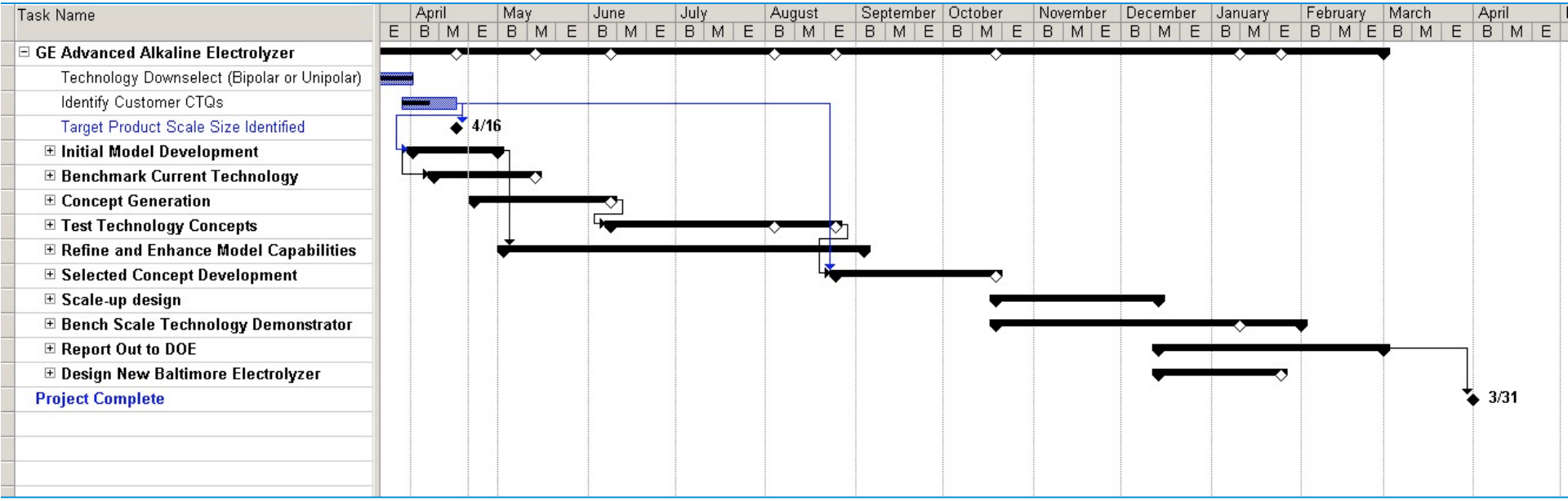


DOE Project Timeline



Low-Fidelity System Performance and Cost Models Needed Early

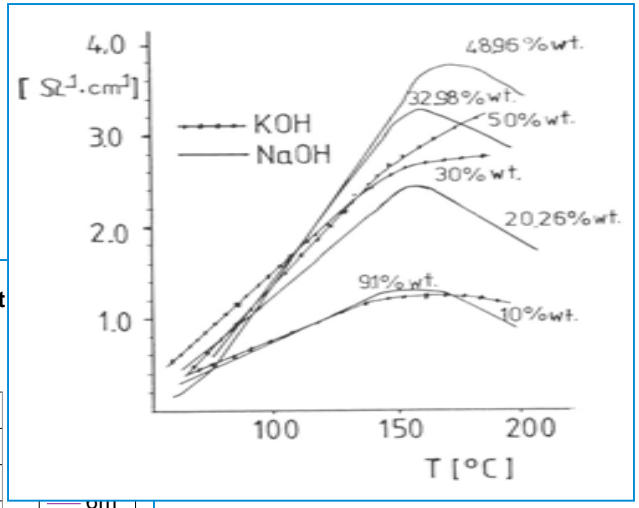
Project Timeline (2)

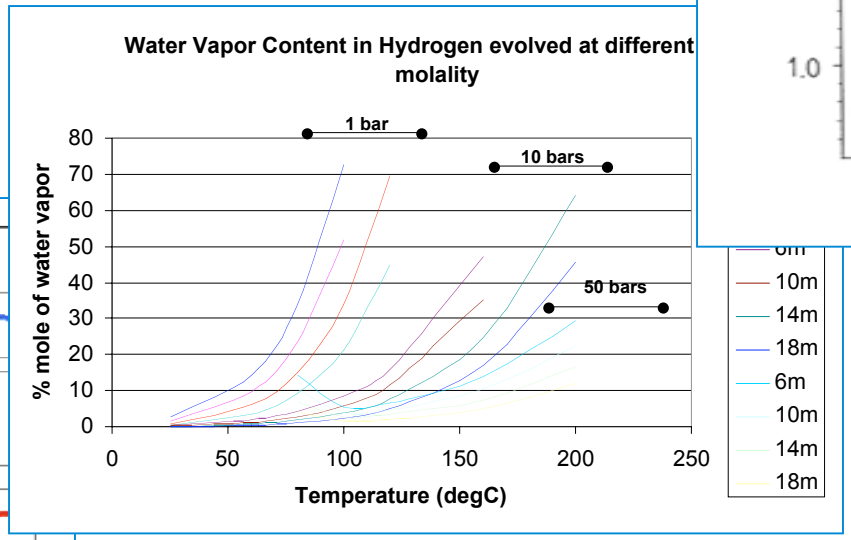


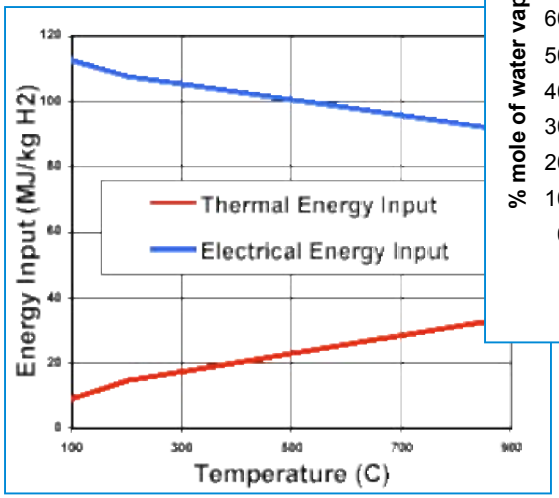
Accomplishments and Progress (1)

(project commenced April 1st 2004)

Understanding effects of temperature on alkaline electrolysis

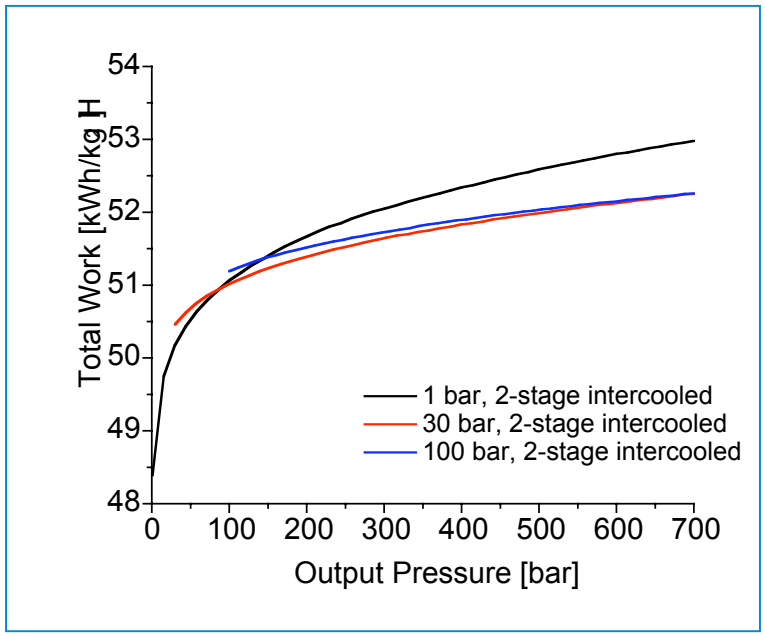


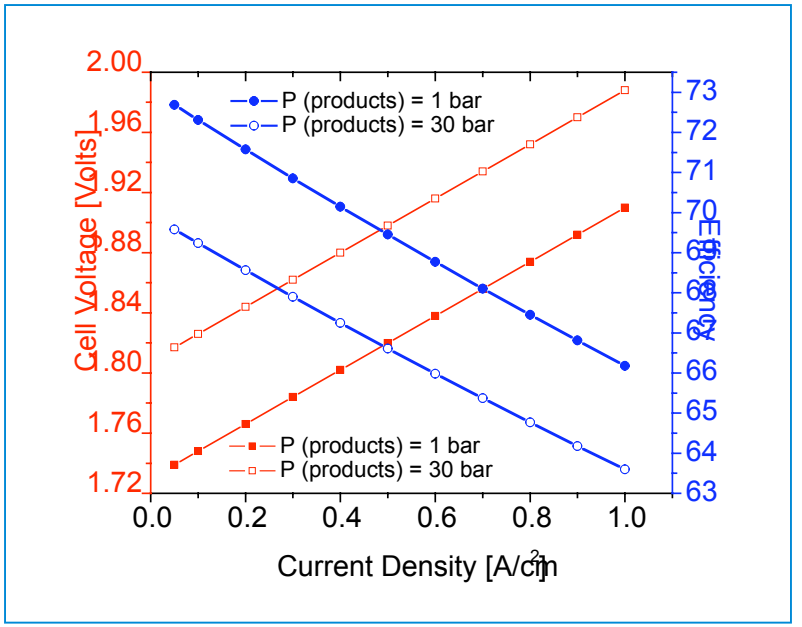




Accomplishments and Progress (2)

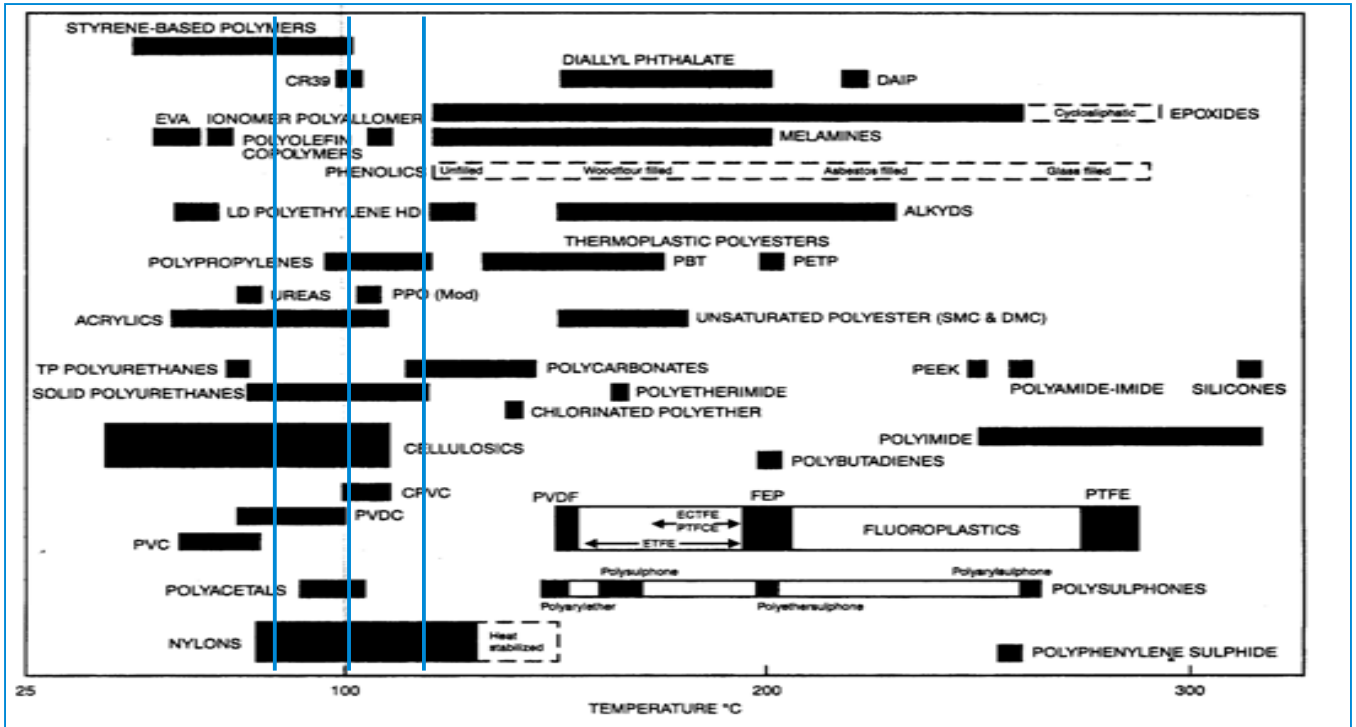
Understanding effects of pressure and current density on alkaline electrolysis





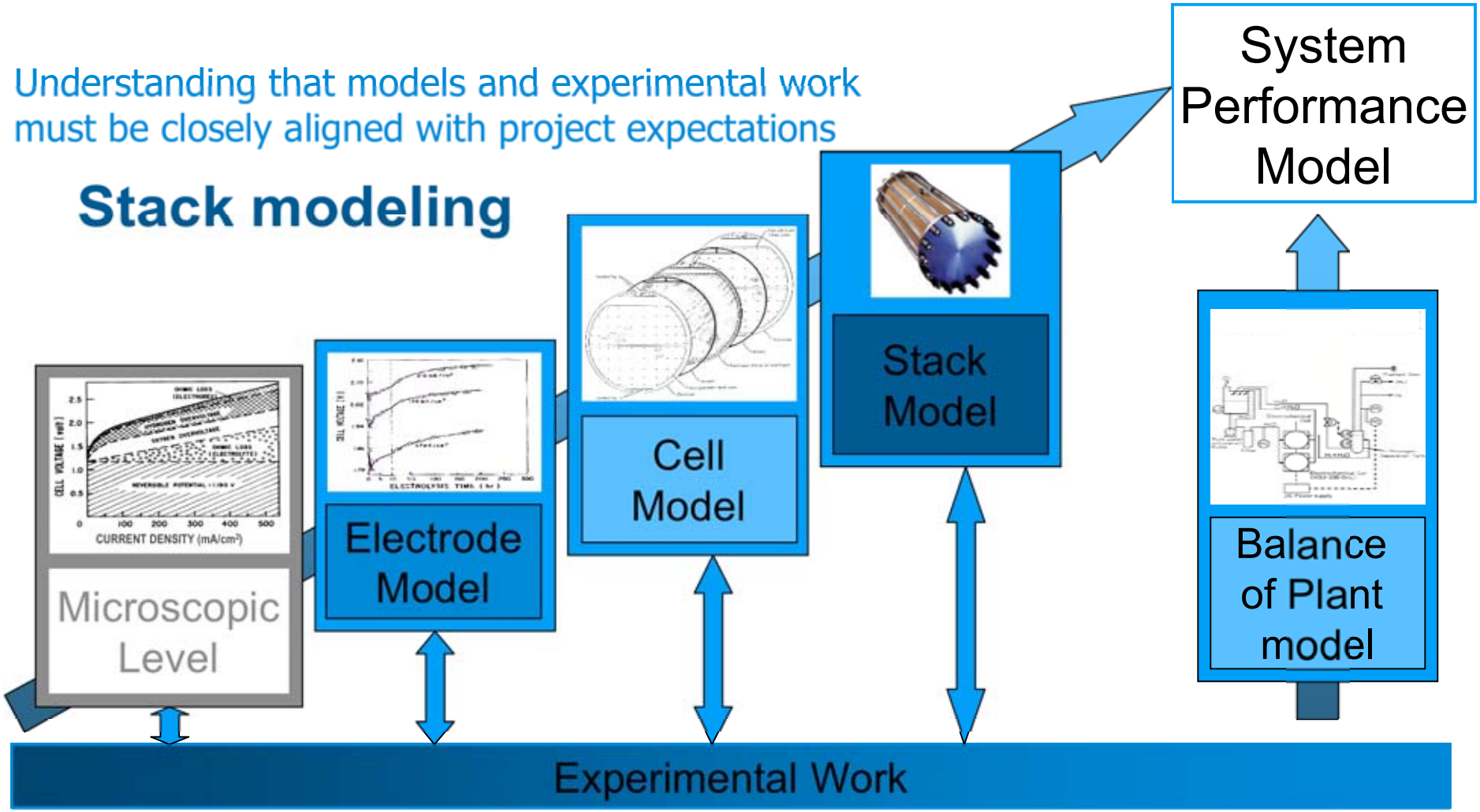
Accomplishments and Progress (3)

Understanding that material properties may limit operating conditions – and vice-versa

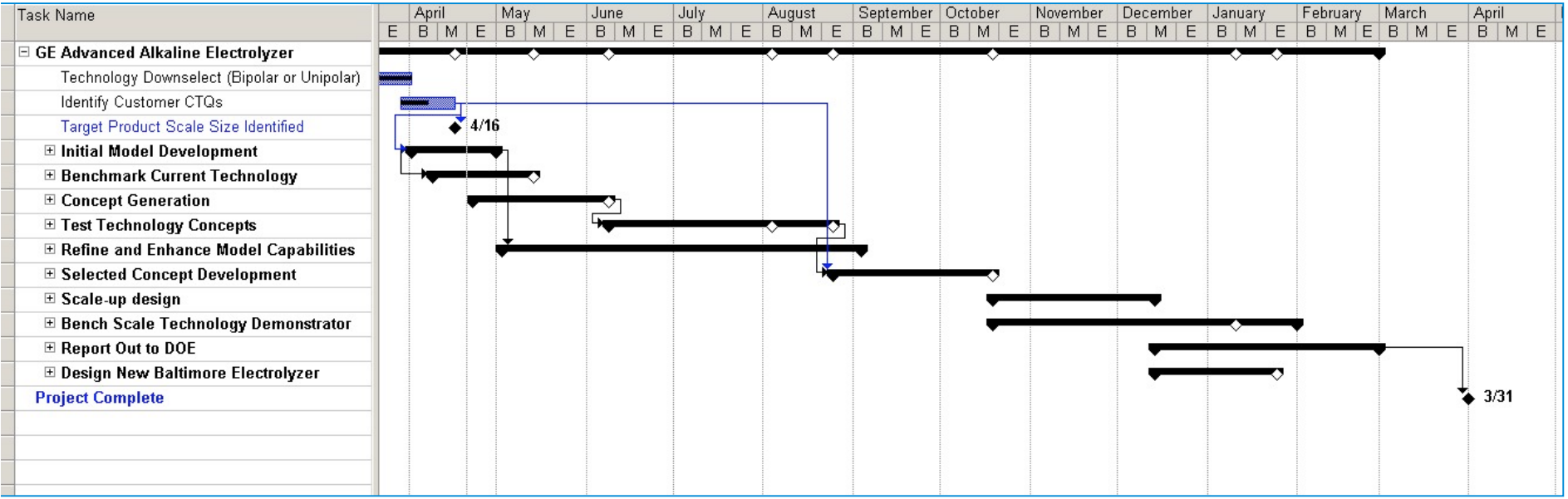


Accomplishments and Progress (4)

Understanding that models and experimental work must be closely aligned with project expectations

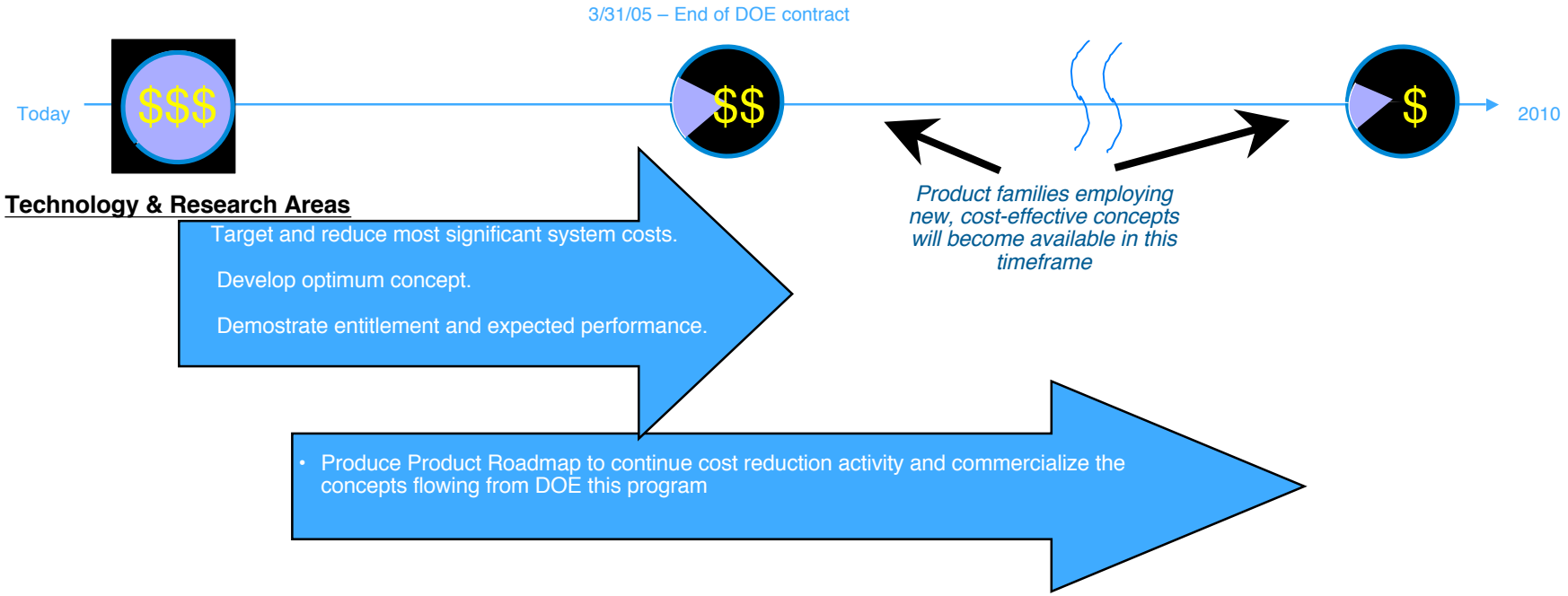


Future Work (1)



Future Work (2)

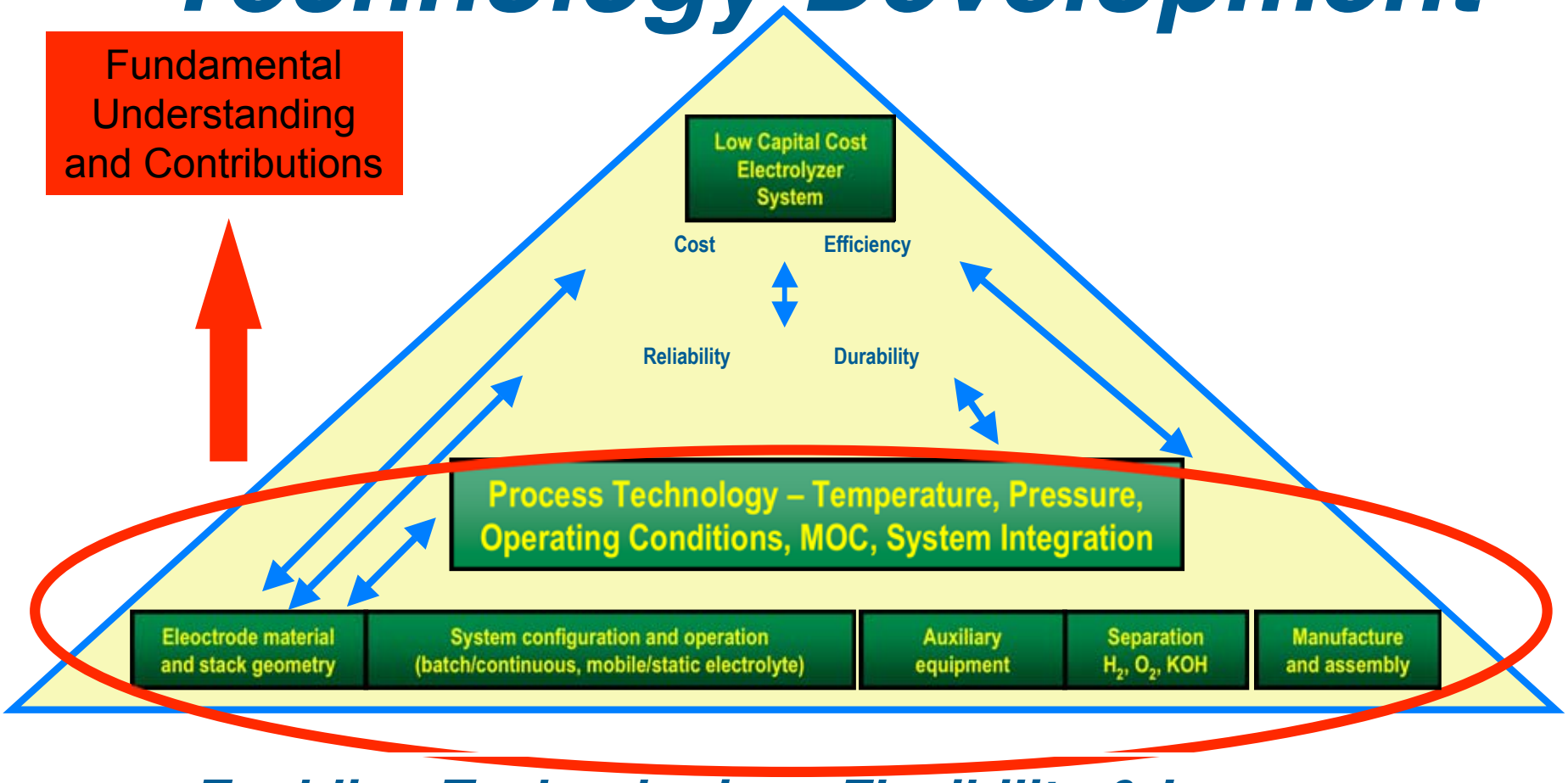
Technology Vision



Significant reduction in* electrolyzer system *costs

Future Work (3)

Technology Development



Enabling Technologies: Flexibility & Leverage